

New and Improved GLDAS data sets and data services at NASA GES DISC

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Introduction

- The goal of a Land Data Assimilation System (LDAS) is to ingest satellite- and ground-based observational data products, using advanced land surface modeling and data assimilation techniques, in order to generate optimal fields of land surface states and fluxes data and, thereby, facilitate hydrology and climate modeling, research, and forecast.
- With the motivation of creating more climatologically consistent data sets, NASA GSFC's Hydrological Sciences Laboratory has generated more than 60 years (Jan. 1948 – Dec. 2008) of Global LDAS Version 2 (GLDAS-2) data, by using the Princeton Forcing Data Set (Sheffield et al., 2006) and upgraded versions of Land Surface Models (LSMs).
- GLDAS data and data services are provided at NASA GES DISC Hydrology Data and Information Services Center (HDISC), in collaboration with HSL and LDAS.

GLDAS Version 2 (GLDAS-2) Data

- GLDAS-2 Noah Experiment-1 monthly and 3-hourly $1^{\circ} \times 1^{\circ}$ data sets (1948-2008) have been released to the public by the NASA GES DISC.
- While GLDAS-2 data are becoming available incrementally, more than 30 years (Jan. 1979–present) of GLDAS Version 1 (GLDAS-1) data, simulated by CLM, Mosaic, NOAH, and VIC models, remain publicly accessible and are still growing.

GLDAS Basic Characteristics

| | |
|-----------------------|---|
| Content | Water and energy budget data forcing data |
| Spatial coverage | All land north of 60° South |
| Spatial resolution | 0.25° and 1.0° |
| Temporal coverage | Version-1 1.0° : Jan. 01, 1979 - present 0.25° : Feb. 24, 2000 - present Version-2 1.0° : Jan. 01, 1948 - 2008 |
| Temporal resolution | 3-hourly and monthly |
| Forcing | Multiple data sets derived from satellite measurements and atmospheric analyses |
| Land surface models | CLM, Mosaic/Catchment, NOAH VIC |
| Output format | GRIBbed Binary (GRIB) |
| Elevation definition | GTOPO 30 |
| Vegetation definition | University of Maryland, 1 km |

Hydrology Data Holdings Portal: <http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings>

The portal lists all GLDAS and NLDAS data sets along with links for accessing the data via Mirador, GDS, ftp, Giovanni, and README document.

Updates to Each GLDAS-2 Land Surface Models

| Model - resolution | GLDAS-1 | GLDAS-2 | Remarks |
|---|--|---------------------------------------|--|
| NOAH $1^{\circ} \times 1^{\circ}$ | Version 2.7 | Version 3.3 | Updated model parameters that specify the initial soil temperature |
| CLM $1^{\circ} \times 1^{\circ}$ | Version 2.0 | Version 3.5 | Used MODIS based parameter data sets, stand alone |
| VIC $1^{\circ} \times 1^{\circ}$ | Water balance mode | Energy balance mode | Includes all variables |
| Mosaic $1^{\circ} \times 1^{\circ}$ | Mosaic (GSFC) | | Model switch |
| Catchment $1^{\circ} \times 1^{\circ}$ | | Catchment | |
| NOAH $0.25^{\circ} \times 0.25^{\circ}$ | Version 2.7, Snow DA: direct insertion | Version 3.3, Snow DA: forward-looking | Updated bottom temperature |

References

- Rodell, M., P. R. Houser, U. Jambor, J. Gottschalck, K. Mitchell, C.-J. Meng, K. Arsenault, B. Cosgrove, J. Radakovich, M. Bosilovich, J. K. Entin, J. P. Walker, D. Lohmann, and D. Toll, The Global Land Data Assimilation System, Bull. Amer. Meteor. Soc., 85(3): 381-394, 2004.
- Mitchell, K.E., D. Lohmann, P.R. Houser, E.F. Wood, J.C. Schaake, A. Robock, B.A. Cosgrove, J. Sheffield, Q. Duan, L. Luo, R.W. Higgins, R.T. Pinker, J.D. Tarpley, D.P. Lettenmaier, C.H. Marshall, J.K. Entin, M. Pan, W. Shi, V. Koren, J. Meng, B.H. Ramsay, and A.A. Bailey, The multi-institution North American Land Data Assimilation System (NLDAS): Utilizing multiple GCIP products and partners in a continental distributed hydrological modeling system, J. Geophys. Res., 109, D07S90, doi:10.1029/2003JD003823, 2004.
- Sheffield, J., G. Goteti, and E. F. Wood, Development of a 50-yr high-resolution global dataset of meteorological forcings for land surface modeling, J. Climate, 19 (13), 3088-3111, 2006.

What's New about GLDAS-2 Data

Recent updates of Princeton Forcing Data

Princeton Forcing data set (Sheffield et al., 2006) provides near-surface meteorological data for driving land surface models and other terrestrial modeling systems. Since its creation in 2006, the data set has been updated and improved several times. The latest update includes correction in Downward Shortwave Radiation, Humidity, and Temperature fields, http://hydrology.princeton.edu/data/pgf/1.0deg/3hourly/Readme_3hourly.txt.

GLDAS-2 data will be generated by using:

- Updated models (Noah, Catchment, CLM, and VIC)
- Updated land cover, land mask, and other vegetation maps based on MODIS data
- Experiment 1 (1948 – present): Updated Princeton Forcing Data
- Experiment 2 (2001 – present): Observation based forcing data

➤ GLDAS-2 NOAH Model Data:

Current GLDAS-2 Noah Model (V2.71) Experiment 1 Data ($1^{\circ} \times 1^{\circ}$ monthly and 3-hourly) will be updated by regenerating the data with updated Noah model (Noah3.3), the updated Princeton Forcing Data, and the updated land surface parameters. $0.25^{\circ} \times 0.25^{\circ}$ monthly and 3-hourly data are coming soon in summer 2012.

➤ GLDAS-2 Catchment Model Data:

- Catchment model was developed by Randy Koster et al at GSFC (the same group who developed Mosaic).
- $1^{\circ} \times 1^{\circ}$ monthly and 3-hourly Experiment 1 Data are coming soon in summer 2012.
- Similar to Noah model data, Catchment model data contain 29 variable fields.
- However, unlike most LSMs, the soil water prognostic variables are not strictly associated with soil layers, <http://hsipp.gsfc.nasa.gov/research/land/catchment.html>.

➤ GLDAS-2 CLM and VIC Model data will also be forthcoming.....

Please visit GES DISC Hydrology Portal for updates, <http://disc.sci.gsfc.nasa.gov/hydrology>.

Improvements in GLDAS-2 Data

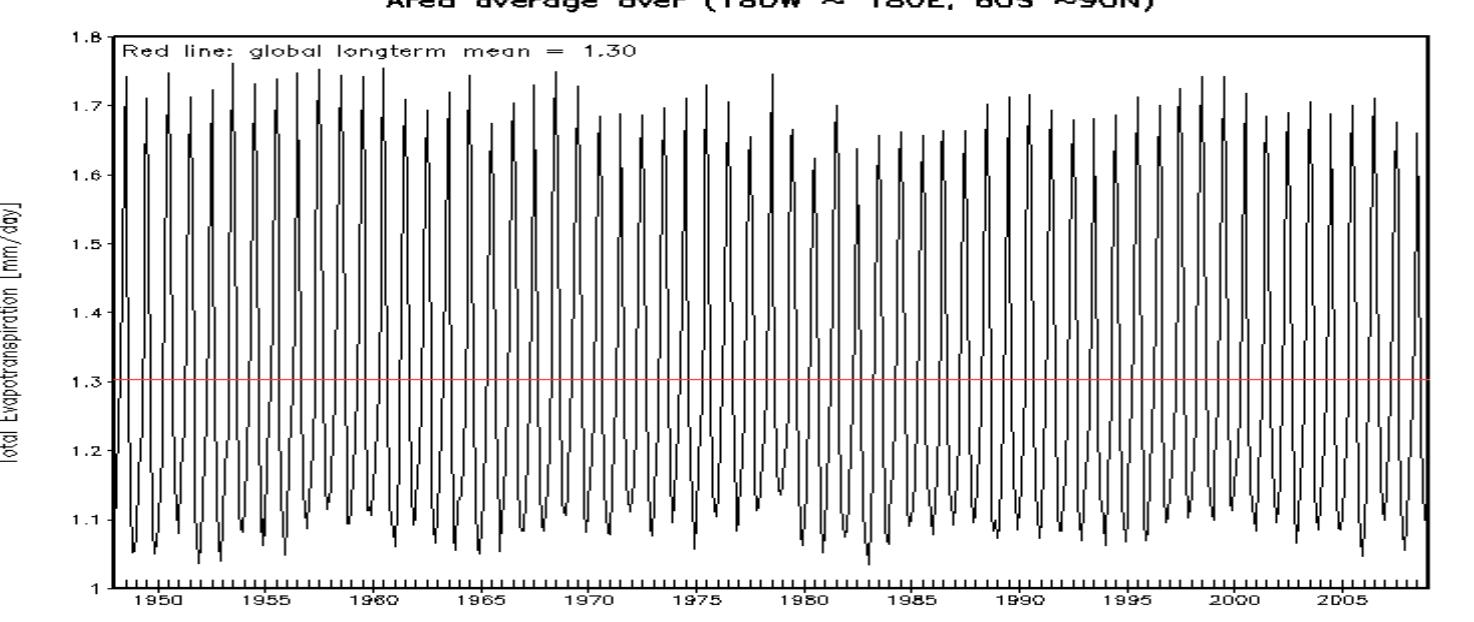
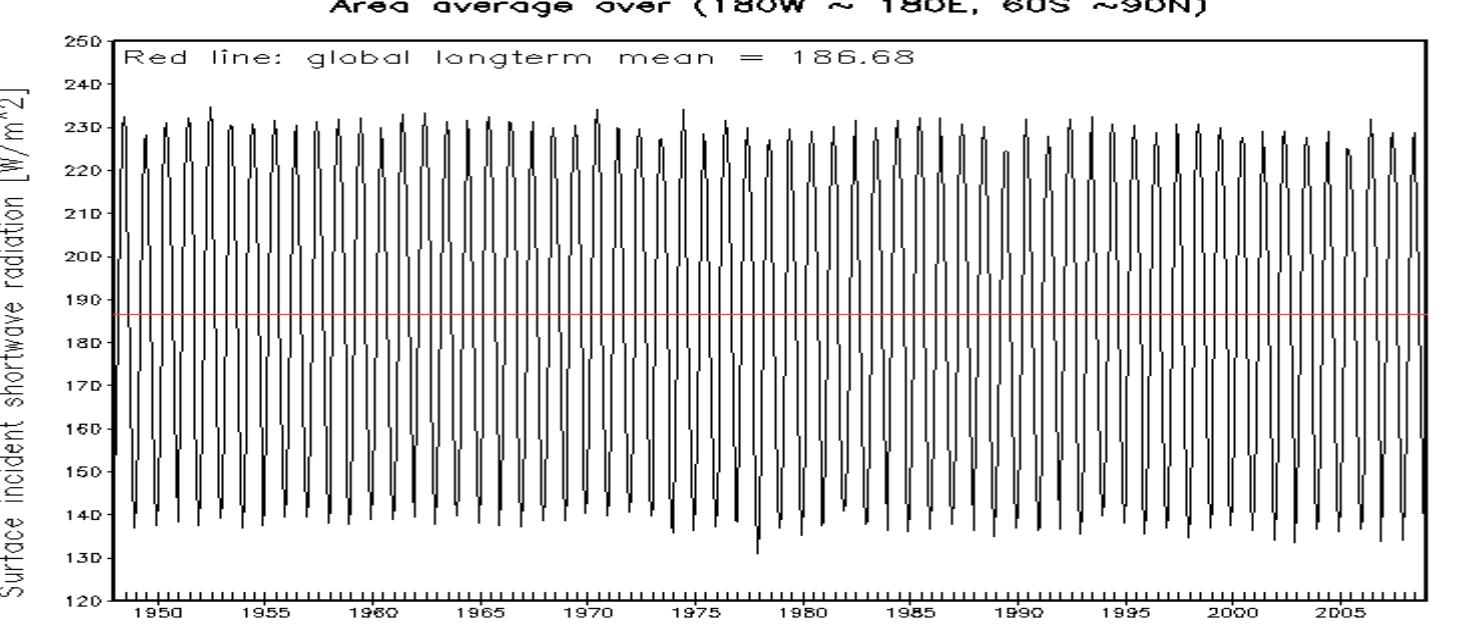
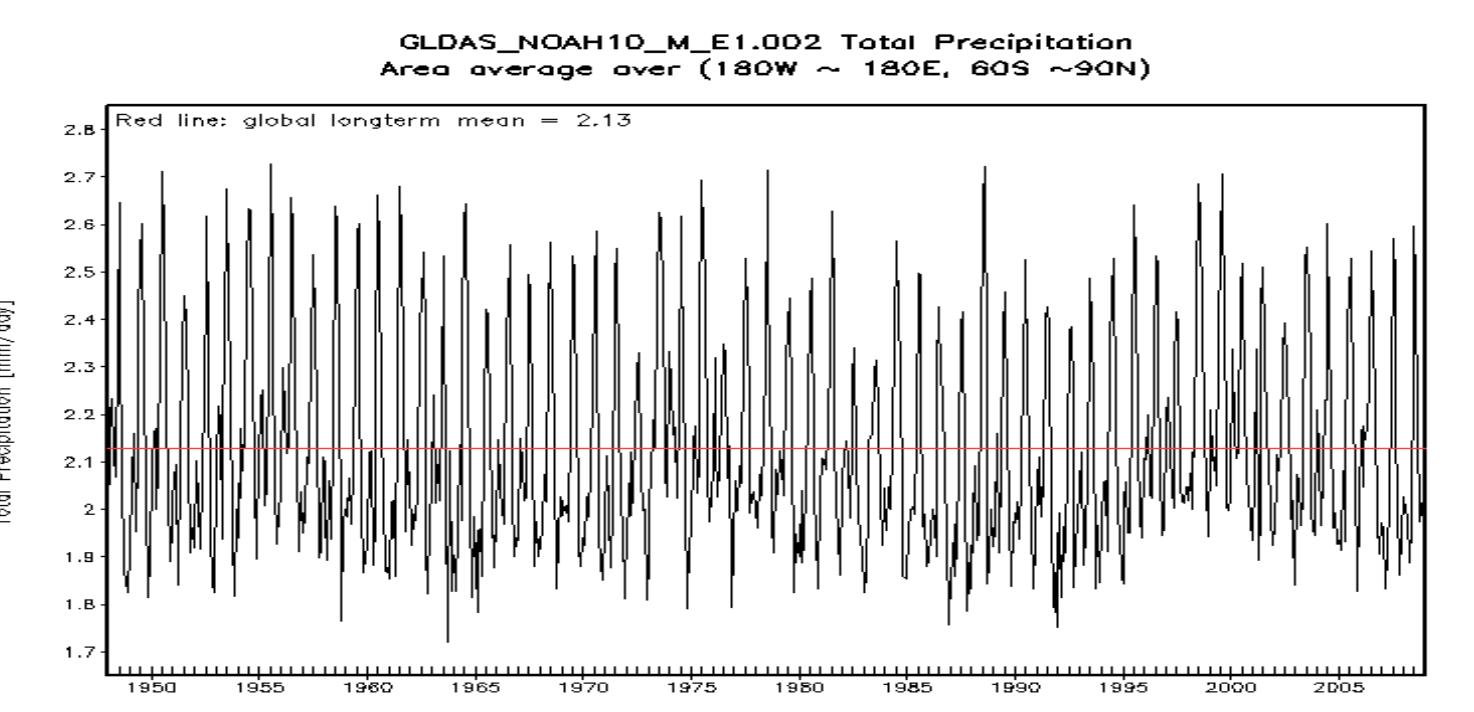
➤ In GLDAS-1, source of forcing data was changed several times during the 30-year data record. As a result, model output data show some discontinuities corresponding to dates of forcing data changes.

➤ GLDAS-2, using the improved forcing data from Princeton, has generated 61 years of improved and climatologically consistent data, using updated LSMs.

➤ The global mean time series of Total Precipitation (rainfall + snowfall, right-upper) and Surface Incident Shortwave Radiation (right-middle) show 61-year temporally consistent data.

➤ Global mean time series of Total ET (right-lower) shows the improvement of the 61-year consistent intensity and annual cycles.

➤ Other variables (not shown here) of GLDAS-2 model outputs also show improved data consistency.



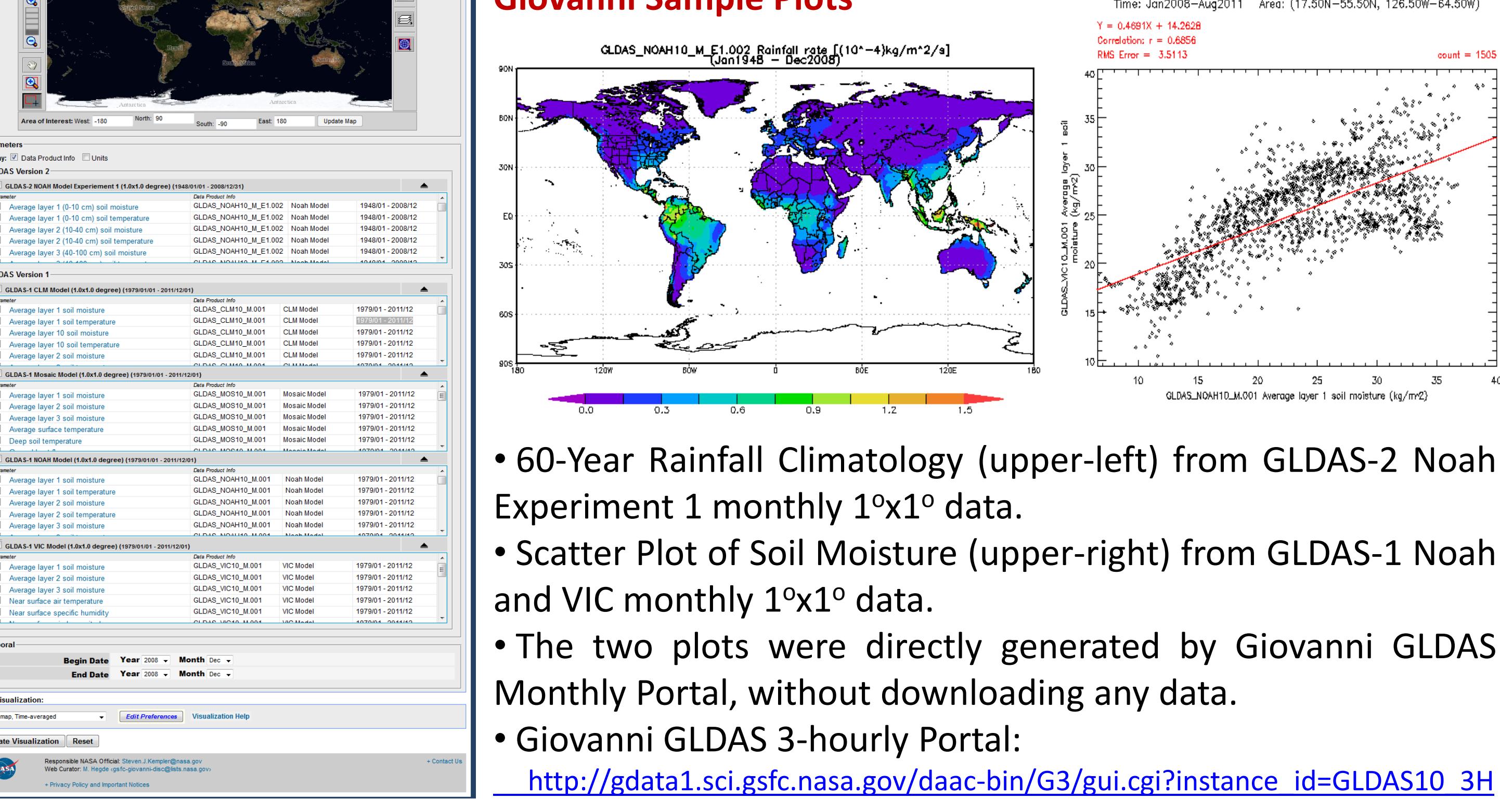
Giovanni Portal for GLDAS Data

http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=GLDAS10_M

Giovanni is a Web-based application developed by NASA GES DISC that provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data.

Giovanni GLDAS Monthly Portal provides online visualization, analysis, and intercomparison for monthly 1×1 GLDAS-1 and GLDAS-2 data from CLM, Mosaic, Noah, and VIC models.

Giovanni Sample Plots



- 60-Year Rainfall Climatology (upper-left) from GLDAS-2 Noah Experiment 1 monthly $1^{\circ} \times 1^{\circ}$ data.
- Scatter Plot of Soil Moisture (upper-right) from GLDAS-1 Noah and VIC monthly $1^{\circ} \times 1^{\circ}$ data.
- The two plots were directly generated by Giovanni GLDAS Monthly Portal, without downloading any data.
- Giovanni GLDAS 3-hourly Portal:
http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=GLDAS10_3H

NLDAS Data at NASA GES DISC

➤ More than 30 years of North American Land Data Assimilation System Phase 1 (Aug. 1996 – Dec. 2007) and Phase 2 (Jan. 1979 – present, with a latency about 4 days) are also accessible via Hydrology Data Holdings Portal, <http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings>.

- Available NLDAS data are $0.125^{\circ} \times 0.125^{\circ}$ hourly data. Monthly data will be coming soon.
- NLDAS Phase 2 (NLDAS-2) Noah model data have been released to public recently.
- NLDAS data from SAC and VIC will also become available soon.
- All NLDAS data are accessible via Giovanni NLDAS Hourly Portal, http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=NLDAS0125_H.

Summary

➤ To date, GLDAS and NLDAS have generated more than 60 years (1948 – present) and 30 years (1979 – present) of data, respectively. These quality-controlled, spatially and temporally consistent terrestrial hydrological data could play an important role in characterizing the spatial and temporal variability of water and energy cycles and supporting climate research.

➤ All data are accessible at NASA GES DISC Hydrology Data Holdings via Mirador, ftp, GDS, or Giovanni (<http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings>).

➤ Giovanni GLDAS and NLDAS portals further facilitate access and use of the data. The portals provide a simple and intuitive way to visualize, analyze, and access the data without having to download the data.

➤ GLDAS-2 Experiment 1 data (1948-2008) will be generated by using updated Princeton Forcing Data, updated LSMs, and updated land surface data. Current existing GLDAS-2 Experiment 1 Noah data will be regenerated.

➤ GLDAS-2 Experiment 2 data (2001 – present) will be generated by using observation based forcing data, with a latency of around a month.

GLDAS is supported by the NASA Energy and Water cycle Study (NEWS).

More information about GLDAS and NLDAS can be found at <http://ldas.gsfc.nasa.gov/>.

NLDAS is a collaboration project among several groups (NOAA/NCEP/EMC, NASA/GSFC, Princeton University, University of Washington, NOAA/OHD, and NOAA/NCEP/CPC) and is a core project of NOAA/MAPP.

